SECURITY CLASSIFICATION: SECRET

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No. 2 of 5 copies

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PROGRESS REPORT

CARGO CHUTE LOCATOR SYSTEM

The purpose for which the Cargo Chute Locator System is intended is fully covered in the original task outline and it is suggested that a review of the outline be made before proceeding with this paper.

The creation of the system involved three steps:-

1. Phase One - Design feasibility and study.

2. Phase Two - Development design.

3. Phase Three - Equipment design.

This report is being submitted at the conclusion of Phase Two. It will supply outlining information necessary to the Government in its proposed field and laboratory tests of the engineering model which, of course, will be simultaneously submitted.

The system consists of two basic units -- a transmitter and a receiver. Each will, in turn, be discussed and its properties compared with the special characteristics or specifications as they were set forth in the original task outline.

A. THE TRANSMITTER

1. General - The transmitter consists of four Type 5906 Subminiature tubes combined as shown in Fig. 1. The oscillator is of the harmonic mode type and is self-pulsed. It produces driving energy for the parallel operated power amplifiers which then need not frequency double. In this manner, an optimum plate efficiency is obtained. Observation of [redacted] Drawing No. 2-224 will show that screen grid modulation is employed. 25X1

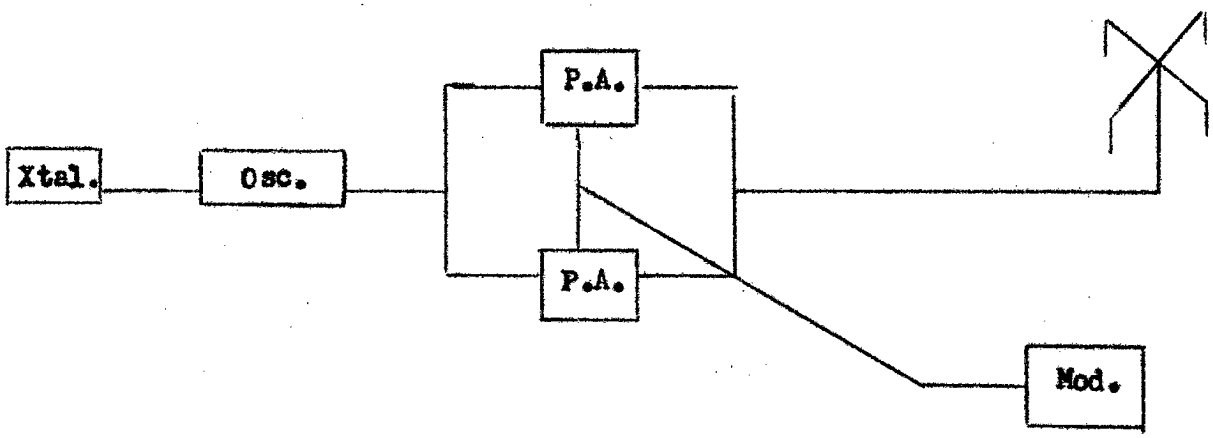

Fig. 1
Transmitter Block Diagram

2. Special Characteristics

(a) *(6.1.1.) - Weight. The unit (excluding batteries) weighs 4.7 pounds. With batteries, the total weight becomes 7.7 pounds.

(b) *(6.1.2.) - Size. No requirement was stated. The unit is reasonably small.

(c) *(6.1.3.) - Form Factor. The box is completely self-contained and has a flat shape so that it will not protrude excessively from the cargo.

(d) *(6.1.4.) - Ruggedness. The outside container consists of a thick laminated plastic material reinforced with a heavy aluminum rib. The end sections are also of laminated plastic with extended lips so that any crushing force resulting from the drop is applied in the plane of the lips. At the same time, the lips support the main body of the box above the cargo so that the crushing force first produces flexure before finally commencing to squeeze the unit. Momentary blows produced by a rolling cargo are then less likely to cause serious damage. (Fig. 2)

* signifies the paragraph referred to in the task outline.

Internally, all major segments such as the batteries are shock mounted in rubber. The tubes themselves are capable of withstanding impact accelerations up to 450 g's and uniform accelerations up to 1000 g's. In addition, most of the electronic components are encapsulated in a solid ethoxyline resin plastic block. (This feature was not included for the pilot model so that all the components may easily be observed). The crystal is completely enclosed in a padded aluminum cell whose cover is readily removed for changing frequency.

(e) *(6.1.5.) - Service Life. The unit will last a minimum of 1.5 hours on fresh batteries. Such a safety factor beyond the 30 minute specification is deemed necessary in the event that only stale batteries are available or that sub-zero operating temperatures reduce the battery efficiency.

In this vein, experiments and research have shown that no batteries are capable of operating with reasonable efficiency at low temperatures. During the flight and, perhaps after the drop, the unit may become sufficiently cold so that the whole purpose of the drop is defeated. For this reason, it was decided that some added design features were necessary and heater elements have been incorporated in the battery compartment. It is proposed that during the flight the heaters be plugged into the plane's 24 volt system (a waterproof plug has been provided for this purpose) which will then bring the internal temperature up to approximately 24°C., whereupon the enclosed thermostat will prevent overheating. The insulated side walls and plastic case can be depended upon to retain the warmth after the drop.

(f) *(6.1.6.) - Frequency Stability. The oscillator is crystal controlled and will be well within the frequency tolerances of the system.

(g) *(6.1.7.) - Emission. Modulation is superimposed upon the square wave envelope which is derived from the self-pulsing oscillator. The duty time is approximately 10 milliseconds with a 90 millisecond lapse between pulses; the power amplifiers being held beyond cut-off during the lapse time. Because of the long "on-time" interval, virtually all of the harmonic power contained in the square pulse is within the receiver bandwidth.

* signifies the paragraph referred to in the task outline

(h) *(6.1.8.) - Channels. One changeable pre-set channel has been supplied.

(i) *(6.1.9.) - Construction. The specifications state that no waterproofing is necessary. This point could prove to be of supreme importance should the unit land in a pool of water or in a marsh. In contradiction of the specification, the enclosed box has been waterproofed and all exposed components accordingly designed.

(j) *(6.1.10.) - Finish. The finish is camouflaged and non-reflecting.

B. THE RECEIVER

1. General - The receiver is a superheterodyne with the following functional stages:-

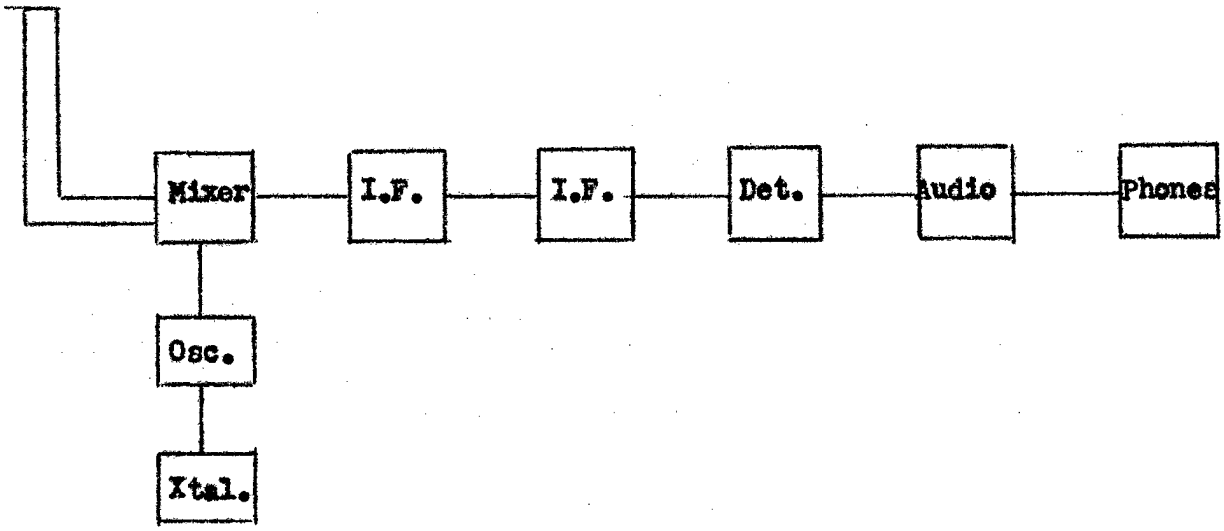

Fig. 3
Receiver Block Diagram

From this block diagram, the principle of operation is self-evident.

* signifies the paragraph referred to in the task outline.

2. Special Characteristics

(a) *(6.2.1.) - Weight. The specifications call for a maximum of five pounds. The actual weight, including batteries, is slightly over two pounds.

(b) *(6.2.2.) - Size. The total volume occupied, exclusive of the slight protrusion of the operating controls, is sixty cubic inches. This exceeds the thirty-six cubic inches which were allowed exclusive of antenna. Since the antenna is self-contained, some of this excess may be charged off to the loop. In any event, the overall size is still less than that of a small hand with fingers spread and only 1.8 inches thick.

(c) *(6.2.3.) - Form Factor. The unit is flat and small and may easily be strapped to a person's belt as is a pistol holster. The chutist would then simply direct himself toward the loudest signal.

(d) *(6.2.4.) - Controls. At present, there are four controls -- the crystal selector switch, R.F. peaking control, oscillator trimmer control, and R.F. gain control combined with the On/Off switch. The Government tests will show if the oscillator trimmer and R. F. gain controls are necessary.

(e) *(6.2.5.) - Ruggedness. Most of the electronic components are rigidly fastened to an aluminum chassis or to a terminal board. The tubes are set against a rubber cushion and the crystals are held in place by flexible clamps capable of slight "give" during impact.

(f) *(6.2.6.) - Service Life. The specifications read two hours. Using fresh batteries, a two-hour life span with good sensitivity is to be expected; however, in extreme cold the jumper should strap the unit near his body during the flight. This will permit some compromise in battery efficiency

(g) *(6.2.7.) - Frequency Stability. The receiver is also crystal controlled, thus making its stability compatible with that of the transmitter.

* signifies the paragraph referred to in the task outline.

(h) *(6.2.8.) - Channels. Six pre-set channels are supplied. The desired channel is selected by means of a front panel control.

(i) *(6.2.9.) - Construction. The unit is shower-proof; however, the fungus and tropicalization treatments have been omitted in the engineering model. A false front cover will be provided to meet the sterility and burial specifications.

(j) *(6.2.10.) - Finish. The external finish is camouflaged and non-reflecting.

C. OPERATION and INSTALLATION PROCEDURE

NOTE: Both transmitter and receiver have been pre-aligned on 44.96 Mc. and are prepared to operate as they are received by the Government.

1. THE TRANSMITTER

(a) Tuning -

WARNING: BE CERTAIN THAT THE POWER SWITCH IS IN THE OFF POSITION BEFORE INSTALLING BATTERIES.

Initially, the four "B" batteries (BA-53) may be set into the compartment provided for them and the connectors snapped into place. Six fasteners must then be tightly screwed in to ensure waterproofing of the battery area.

The "C" cell (BAZ61-U) must similarly be installed in the opposite end of the case but with careful regard for the marked polarity.

A harmonic mode crystal (CR23/U) of one half the desired output frequency should be placed in the padded cell provided for this purpose. With these simple steps the transmitter has been prepared for its initial tuneup.

It is possible to vary the Oscillator Grid adjustment over a very wide range before crystal control is lost. When loss of crystal control occurs, the pulsing (as viewed on the neon bulb output indicator or picked up on a local receiver such as that supplied with the RS-8)

* signifies the paragraph referred to in the task outline.

becomes erratic or very rapid. It is, therefore, evident that this adjustment will have been properly made when pulsing very roughtly approaches the ten per minute design center. It is then only necessary to peak up the Oscillator Plate and Final Plate tanks for maximum neon bulb indication and then secure these adjustments by means of the lock nuts on each shaft.

The antenna has been loosely coupled to the Final Plate tank so that variations in its (the antenna's) characteristics due to the presence of a metallic cargo or variations in the ground plane will not seriously affect the tuning. It is advised, however, that the Final Plate tank be retouched after the transmitter has been secured to the cargo and the waterproof cover then screwed into place. When loaded with a 68 ohm non-inductive resistor, the transmitter will produce 2.5 to 3 watts of peak power.

(b) Installation -

Two strong ropes or straps are first used to encircle the caro as illustrated in Fig. 2 ([redacted] 25X1
Drawing No. 2-231). A second shorter set of straps or ropes is then passed through the brackets set into the top of the transmitter case and this set is fastened to the heavier cargo straps as shown. Any alteration or improvisation is, of course, acceptable as long as a secure fastening is obtained.

A second reference to Fig. 2 will illustrate how the four antenna legs may be oriented and fastened to the cargo. Each leg is cut to one quarter wavelength at 45 Mcs. for most efficient operation at this frequency; however, a 5 Mcs. shift in carrier to 40 Mcs. will not materially affect the transmitter output.

For very low termperature operation, the unit is to be plugged into the aircraft 24 volt system to bring the battery compartment up to an efficient operating point. The heating process usually requires little time, depending upon the ambient starting point.

C. OPERATION PROCEDURE (cont'd)

NOTE: To state once again - both transmitter and receiver have been pre-aligned on 44.96 Mcs. and are prepared to operate as they are received by the Government.

2. THE RECEIVER

(a) Field Tuning and Operation -

In order to install the batteries, the knobs must be removed and the front cover slipped off. Since the "B" cells (BA 261/U) are located beneath the "A" cells (BA 42), the former must first be pressed into place. In all cases, careful notice must be made of the marked polarity.

For crystal installation, the entire aluminum chassis and plastic battery compartment may be simultaneously slipped out of the case. The crystal used should be of the harmonic mode type (CR 23/U) ground for 4.96 Mcs. below the desired carrier frequency.

$f_x = f_c - 4.96$ where: f_x = crystal frequency
f_c = Carrier frequency

and both are in Mcs.

Once the batteries have been installed, the crystals inserted, and the front cover and the knobs have been replaced, the unit is prepared to operate.

The crystal switch should then be turned to the appropriate position and the R.F. gain turned full clockwise and both the R.F. peaking and Oscillator Trimmer set for maximum output in the phones. The Oscillator trimmer will be found necessary only when the transmitter is at a sufficiently great distance to produce a weak signal. The loop edge of the case may now be turned toward the cargo for sensing.

(b) Test Bench Tuning -

The I.F.'s are aligned by injecting a 4.96 Mc. signal (30% Mod.) at the grid of V106 (Pin #3) and peaking L 104, L 105, and L 106 for maximum output across the phones. A sensitivity of 100 microvolts or less will

produce a fairly discernible signal of .01 volts across the phones.

Since the loop cannot be removed without disrupting the R.F. input circuit, coupling from the generator to the receiver at the carrier frequency must be accomplished by placing the generator lead in the vicinity of the loop. Sufficient pickup will be obtained in this manner to permit optimum alignment of L 101 and L 102.

ENGINEERING SKETCH — NOT FOR PRODUCTION

TOLERANCES
UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS MAY VARY +.005-.005
FRACTIONAL DIMENSIONS MAY VARY +1/64,-1/64
DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED IN THE ABOVE.

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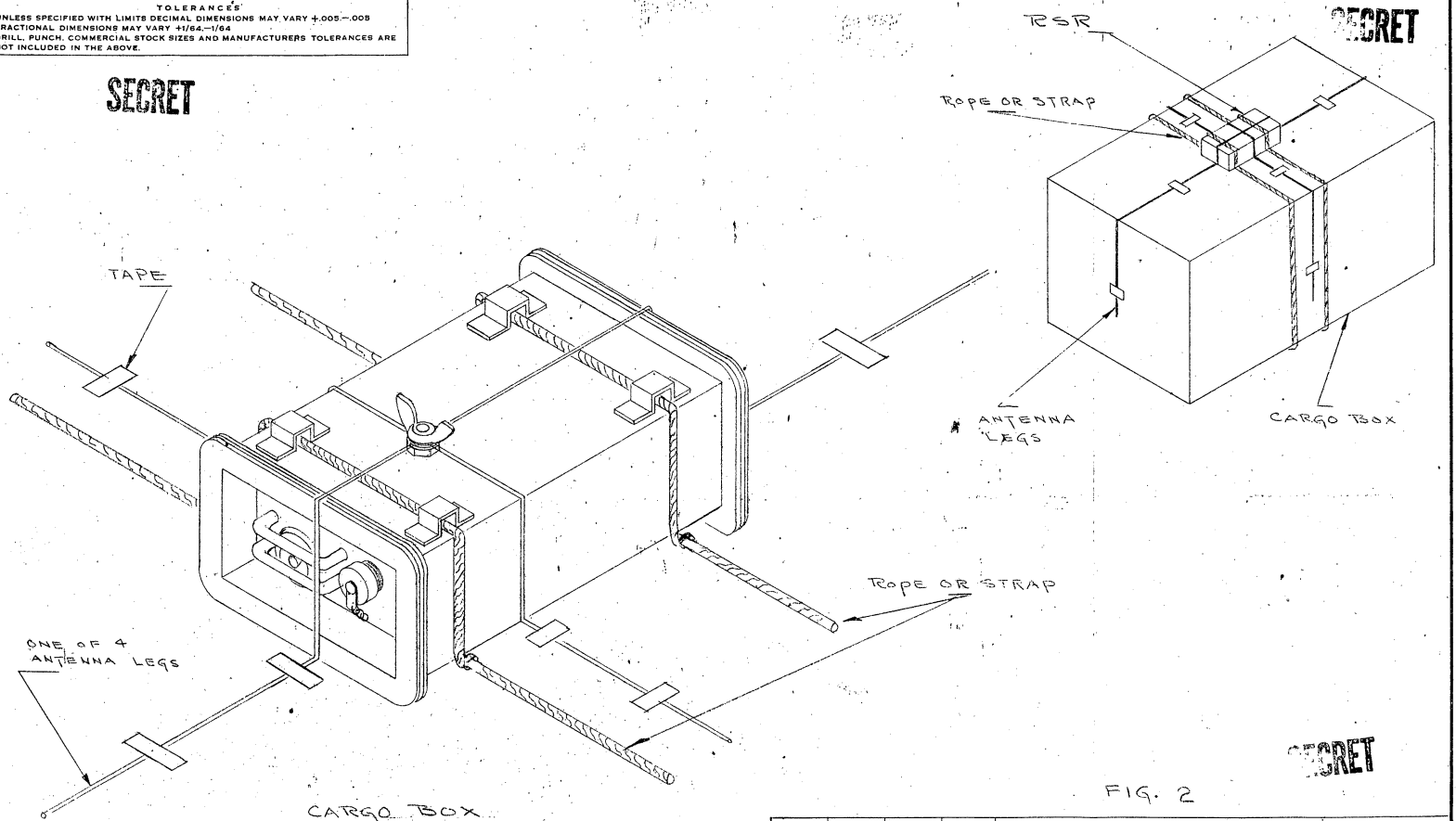

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FIG. 2

ISSUE	DATE	BY	APP.	TITLE TRANSMITTER MOUNTING			
				MATERIAL	FINISH	DATE 7/1/53	2-231
				FILE	CHECK'D A. J. J.	ENG. A. J. J.	

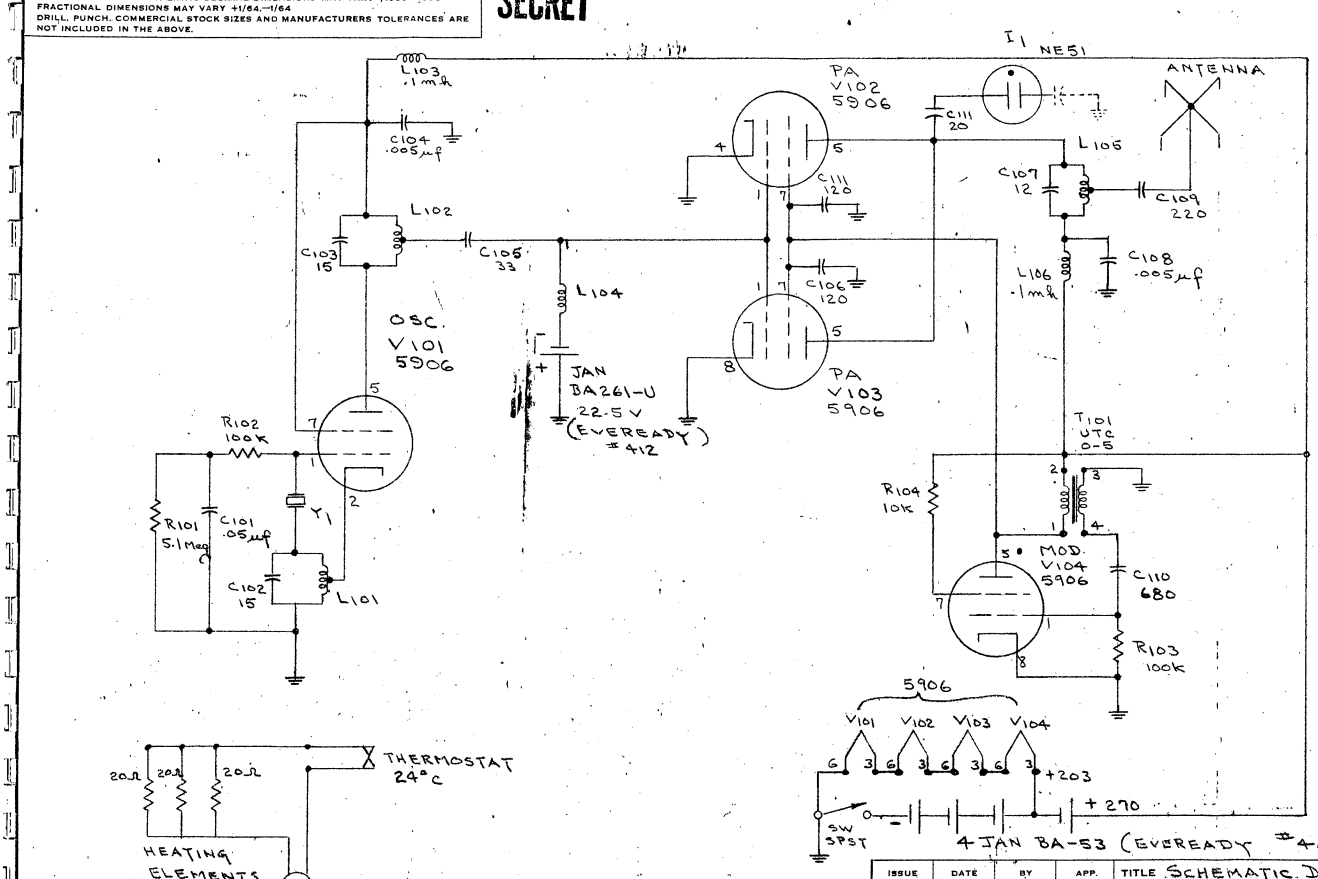
25X1

FORM — 107

ENGINEERING SKETCH - NOT FOR PRODUCTION

TOLERANCES
UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS MAY VARY +.005 -.005
FRACTIONAL DIMENSIONS MAY VARY +1/64, -1/64
DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED IN THE ABOVE.

SECRET



NOTE:
ALL CAPACITORS IN μμf EXCEPT WHERE OTHERWISE STATED.
ALL RESISTORS 1/2 WATT

SECRET

SECRET

ISSUE	DATE	BY	APP.	TITLE SCHEMATIC DIAGRAM, TRANSMITTER			
				MATERIAL	FINISH	DATE 6-8-53	2-224
				FILE	CHECK'D A.J.J.	ENG. A.J.J.	

FORM — 107

ENGINEERING SKETCH NOT FOR PRODUCTION

TOLERANCES
UNLESS SPECIFIED WITH LIMITS DECIMAL DIMENSIONS MAY VARY +.005-.005
FRACTIONAL DIMENSIONS MAY VARY +1/64-1/64
DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED IN THE ABOVE.

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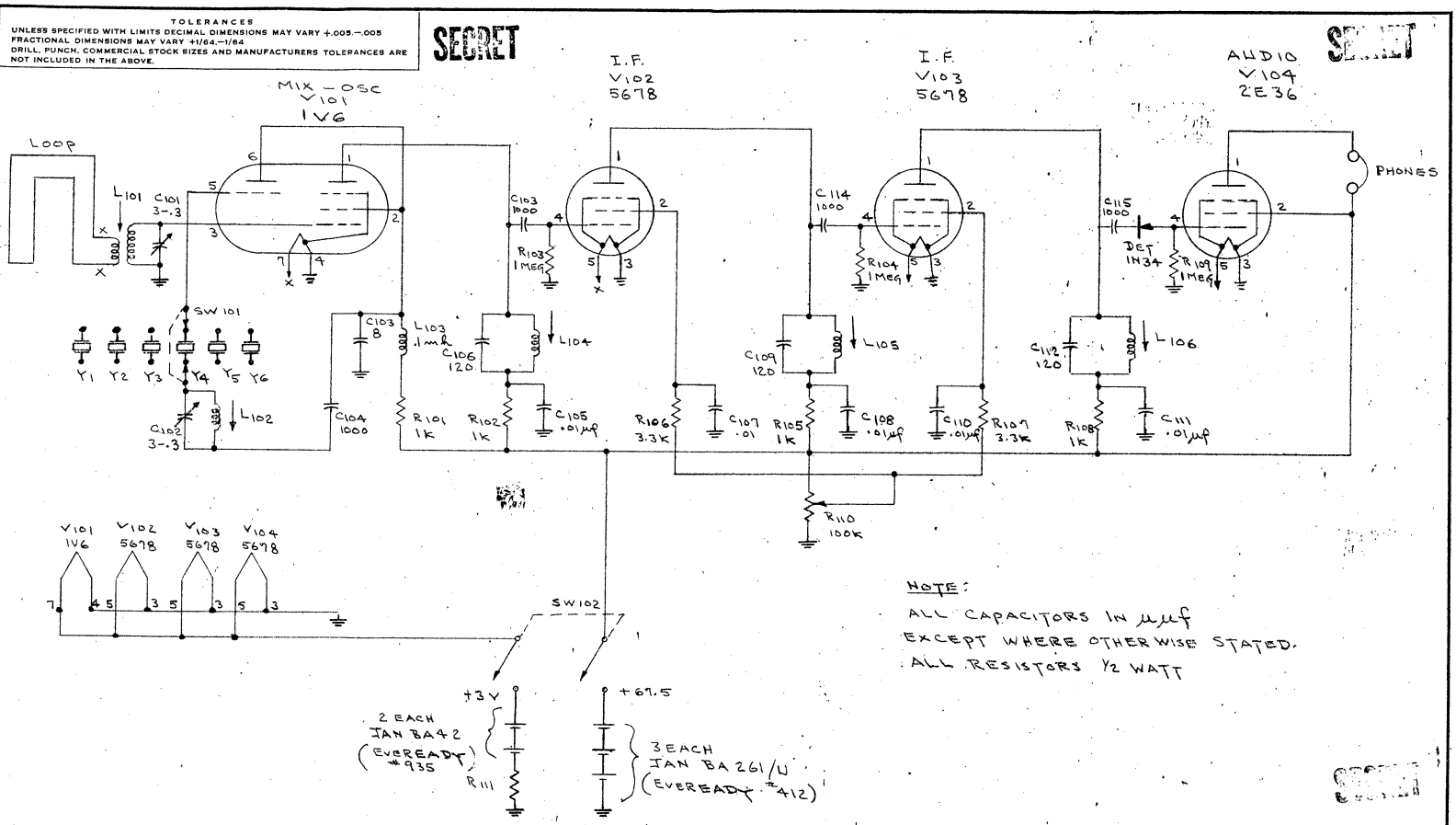

NOTE:
ALL CAPACITORS IN μμf
EXCEPT WHERE OTHERWISE STATED.
ALL RESISTORS ½ WATT

SECRET

SECRET

ISSUE	DATE	BY	APP.	TITLE SCHEMATIC DIAGRAM – RECEIVER			
				MATERIAL	FINISH	DATE 6-8-53	2-223
				FILE	CHECK'D A.J.J.	ENG. A.J.J.	

25X1

FORM — 107

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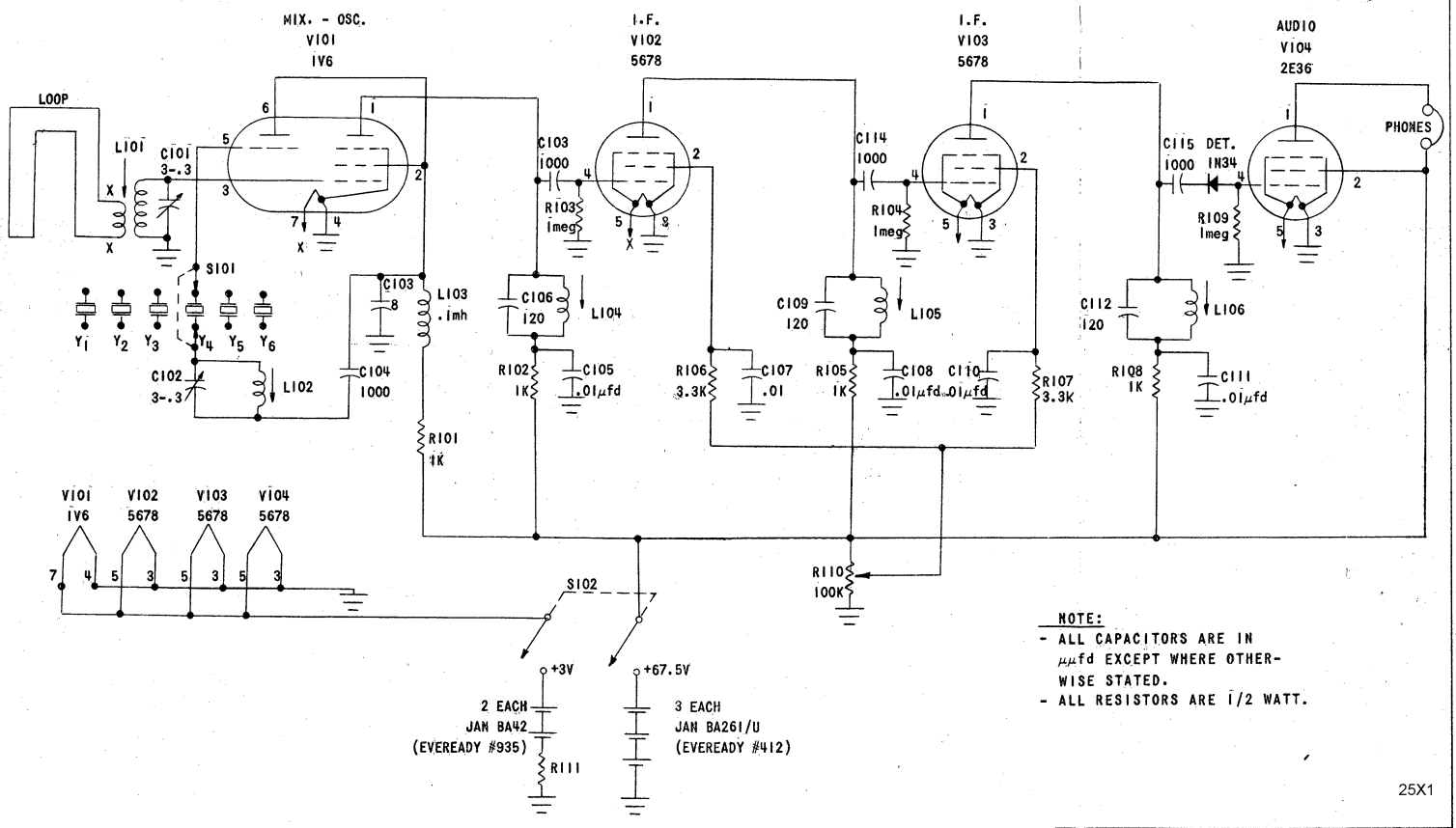


NOTE:
- ALL CAPACITORS ARE IN μμfd EXCEPT WHERE OTHERWISE STATED.
- ALL RESISTORS ARE 1/2 WATT.

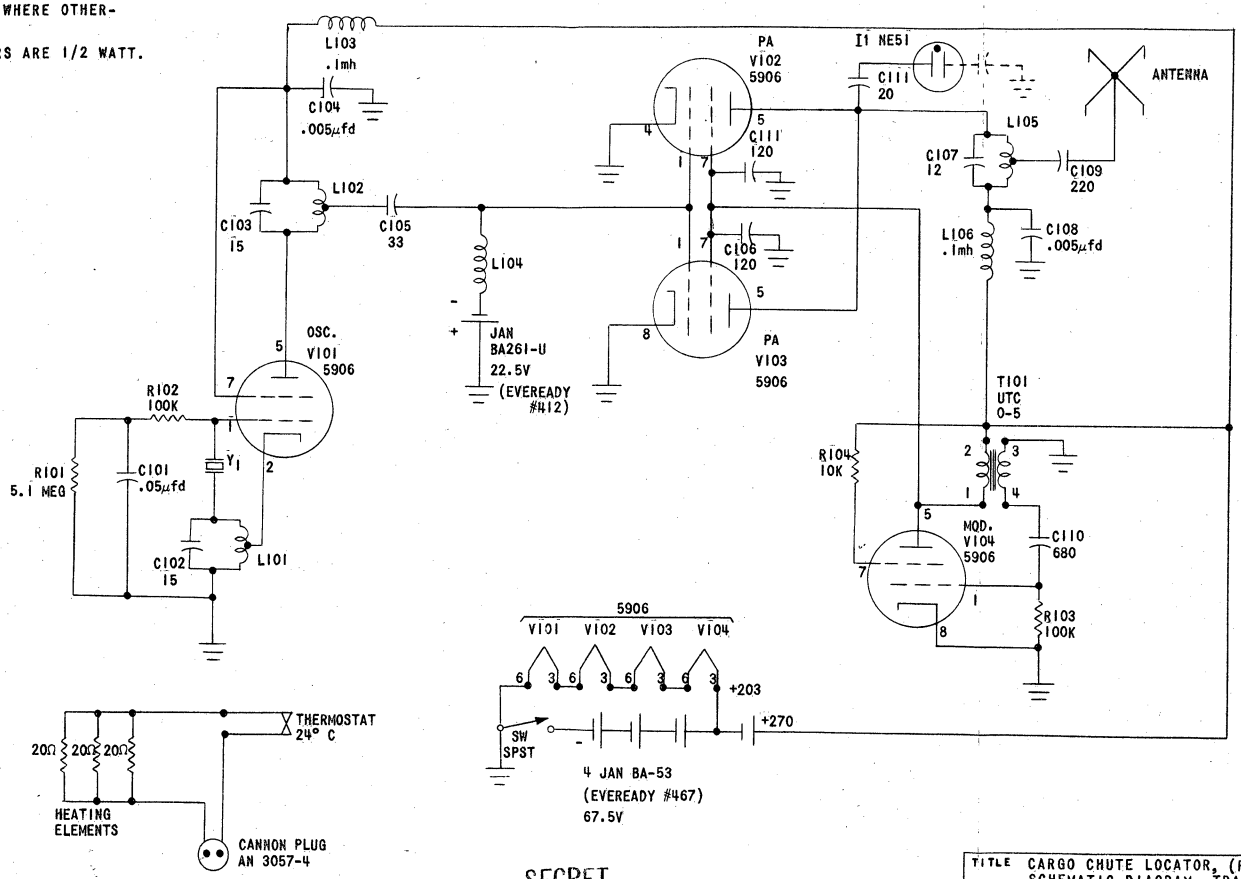
25X1

SECRET

TITLE	CARGO CHUTE LOCATOR, (RS-8) SCHEMATIC DIAGRAM, RECEIVER
DATE	21 MAY 1956
DWG. NO.	COPY OF DRAWING # 2-223

SECRET

NOTE:
- ALL CAPACITORS ARE IN μμfd EXCEPT WHERE OTHERWISE STATED.
- ALL RESISTORS ARE 1/2 WATT.



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SECRET

TITLE	CARGO CHUTE LOCATOR, (RS-8) SCHEMATIC DIAGRAM, TRANSMITTER
DATE	21 MAY 1956
DWG. NO.	COPY OF DRAWING # 2-224